# AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

| 1. CONTRACT ID CODE | PAGE OF PAGES |
|---|---|
| J | 1 \| 3 |

| 2. AMENDMENT/MODIFICATION NO. | 3. EFFECTIVE DATE | 4. REQUISITION/PURCHASE REQ. NO. | 5. PROJECT NO.(If applicable) |
|---|---|---|---|
| 0005 | 21-Apr-2005 | W38XGR-5019-1188 | W912EQ-05-B-0007 |

| 6. ISSUED BY | CODE | 7. ADMINISTERED BY (If other than item 6) | CODE |
|---|---|---|---|
| US ARMY ENGINEER DISTRICT, MEMPHIS<br>167 N MAIN STREET B202<br>MEMPHIS TN 38103-1894 | W912EQ | **See Item 6** | |

| 8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code) | | |
|---|---|---|
| | X | 9A. AMENDMENT OF SOLICITATION NO.<br>W912EQ-05-B-0007 |
| | X | 9B. DATED (SEE ITEM 11)<br>18-Feb-2005 |
| | | 10A. MOD. OF CONTRACT/ORDER NO. |
| | | 10B. DATED (SEE ITEM 13) |
| CODE / FACILITY CODE | | |

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [X] is extended, [ ] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

This solicitation for Francis Bland Floodway Ditch, Item 2 Phase 2 Channel Enlargement is amended as follows:

THE BID OPENING DATE HAS BEEN RESCHEDULED FOR 3 MAY 2005 AT 2:30 P.M.

Continued on next page

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

| 15A. NAME AND TITLE OF SIGNER (Type or print) | | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)<br>TEL: EMAIL: | |
|---|---|---|---|
| 15B. CONTRACTOR/OFFEROR<br>_____<br>(Signature of person authorized to sign) | 15C. DATE SIGNED | 16B. UNITED STATES OF AMERICA<br>BY _____<br>(Signature of Contracting Officer) | 16C. DATE SIGNED |

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

**SUMMARY OF CHANGES**

## SECTION 00010 - SOLICITATION CONTRACT FORM

**1. THE REQUIRED RESPONSE DATE/TIME HAS CHANGED FROM 21-APR-2005 02:30 PM TO 03-MAY-2005 02:30 PM.**

**2. BID SCHEDULE,** is deleted in its entirety and the attached BID SCHEDULE is substituted therefor.

## SECTION 00100 – CONDITIONS AND NOTICES TO BIDDERS

**3. PARAGRAPH B. SITE VISITS** – Change Mr. Stephen P. Shankle's phone number to 573-333-1043.

## SECTION 00800 – SPECIAL CONTRACT REQUIREMENTS

**4. 1.18 WORK ON OR ADJACENT TO RAILROAD PROPERTY, PARAGRAPH b.** – Delete paragraph in its entirety and replace with the following:

"b. Prior to any work being performed on the railroad or railroad property, the Contractor shall give notice, written and/or oral to Mr. Buddy Kreifels, Manager, Track Maintenance, of the Union Pacific Railroad at 870-240-0982, PO Box 997 Paragould, AR 72451, at least twenty-four (24) hours in advance of the time the work is to be performed."

## TECHNICAL SPECIFICATIONS

**5. SECTION 02370, SOIL SURFACE EROSION CONTROL, PARAGRAPH 2.2** – Delete paragraph in its entirety and replace with the following:

"2.2 SEED

2.2.1 Seed Classification and Quality

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws. The Contractor shall submit the Seed Establishment Period information as specified in the Submittals paragraph. Seed shall be furnished in sealed, standard containers unless written exception is granted. Seed that is wet or moldy or that has been otherwise damaged in transit or storage will not be acceptable. Weed seed shall be a maximum one percent by weight of the total mixture. The specifications for seeds shall conform to the following, unless otherwise approved by the Contracting Officer:

| | Minimum Purity | Minimum Germination |
|---|---|---|
| Kind of Seed | Percent | Percent |
| Perennial Rye | 95 | 80 |
| Red Clover | 95 | 80 |
| Bermuda Grass | 95 | 80 |
| Crown Vetch | 95 | 80 |

2.2.2 Seeding

Seed sown during the season between 1 March and 31 May, inclusive, shall consist of 15 pounds of Rye Grass, 40 pounds of hulled Bermuda Grass, 25 pounds of Crown Vetch, and 15 pounds of Red Clover seed per acre. Seed

sown during the season between 15 August and 15 November, inclusive, shall consist of 25 pounds of Rye Grass, 25 pounds of unhulled Bermuda Grass, 20 pounds of Crown Vetch, and 20 pounds of Red Clover seed per acre. A satisfactory method of sowing shall be employed, using approved mechanical power-drawn seeders, mechanical hand-seeders, broadcast-seeders, or other approved methods. When conditions are such by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, work shall be halted as directed and resumed only when conditions are favorable or when approved alternative or corrective measures and procedures have been effected. If inspection either during seeding operations or after there is a show of green indicates that areas have been left unplanted, additional seed shall be sown if so directed."

**6. SECTION 02370, SOIL SURFACE EROSION CONTROL, PARAGRAPH 2.3** – Delete paragraph in its entirety and replace with the following:

"2.3 FERTILIZER

2.3.1 Materials

Fertilizer shall consist of a mixture containing nitrogen, phosphorous, and potash, and shall be uni¬form in composition and free flowing. The fertilizer may be delivered to the site in bags or other convenient containers or delivered in bulk. If delivered in bags or containers, the fertilizer shall be fully labeled in accordance with the applica¬ble fertilizer laws of the State of Arkansas, and shall bear the name, trade name or trademark, and warranty of the producer. The fertilizer shall meet the requirements of the State of Arkansas for commercial fertiliz¬er. Should the commercial fertilizer be furnished in bulk, the Contractor shall furnish certified weight tickets and a certified quantitative analysis report, in tripli¬cate, from a recognized testing laboratory certifying the nutri¬ent ratio of the materials. In the event the commercial mixture is delivered to the job site in the original containers, unopened, the analysis report will not be required.

2.3.2 Application of Fertilizer

Fertilizer shall be distrib¬uted uniformly over the areas to be seeded at a rate which will supply not less than 40 pounds of available nitrogen, 40 pounds of available phosphorous, and 40 pounds of potash per acre and shall be incorporated into the soil by light disking, harrowing, or other acceptable methods immediately following the applica¬tion."

**7. SECTION 02370, SOIL SURFACE EROSION CONTROL, PARAGRAPH 3.7** – Delete paragraph in its entirety.

**8. SECTION 02371A, STONE FILLED WIRE MESH GABIONS AND MATTRESS UNITS** – Section is deleted in its entirety and the attached SECTION 02371A, STONE FILLED WIRE MESH GABIONS AND MATTRESSES is substituted therefor.

**9. SECTION 02542, STONE PROTECTION, PARAGRAPH 1.1** – Add the following references:

"ASTM C 136 (2004) Sieve Analysis of Fine And Coarse Aggregates

ASTM C 33 (2003) Concrete Aggregates"

**10. SECTION 02542, STONE PROTECTION, PARAGRAPH 2.2.1** – After the first sentence add, "The material shall meet the quality requirements of ASTM C 33 for the region in which the project is located."

**11. SECTION 02542, STONE PROTECTION, PARAGRAPH 2.2.2** - After the first sentence add, "The gradation test shall be performed in accordance with ASTM C 136."

(End of Summary of Changes)

Section 00010 - SOLICITATION CONTRACT FORM

FRANCIS BLAND FLOODWAY DITCH, ITEM 2, PHASE 2 CHANNEL ENLARGEMENT
BID SCHEDULE

| ITEM NO | SUPPLIES/SERVICES | QUANTITY | UNIT | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 0001 | Mobilization and Demobilization | 1 | Lump Sum | XXX.XX | _____ |
| 0002 | Clearing | 1 | Lump Sum | XXX.XX | _____ |
| 0003 | Excavation | 387,500 | Cubic Yard | _____ | _____ |
| 0004 | Filter Material | 33,000 | Net Ton (2,000 LB) | _____ | _____ |
| 0005 | Riprap R-200 | 120,000 | Net Ton (2,000 LB) | _____ | _____ |
| 0006 | Riprap R-650 | 3,650 | Net Ton (2,000 LB) | _____ | _____ |
| 0007 | Grout for Key Protection Gabions and Gabion Mattress Units | 1,900 | Cubic Yard | _____ | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 0008 | Stone Filled Wire Mesh Gabions and Gabion Mattress Units | 17,000 | Square Yard | _____ | _____ |
| 0009 | Culvert Cutoff with Riprap Placement | 8 | Each | _____ | _____ |
| 0010 | Corrugated Metal Pipe, 24-inch | 50 | Linear Foot | _____ | _____ |
| 0011 | Corrugated Metal Pipe, 48-inch | 50 | Linear Foot | _____ | _____ |
| 0012 | Flared End Section, 24-inch | 2 | Each | _____ | _____ |
| 0013 | Flared End Section, 48-inch | 1 | Each | _____ | _____ |
| 0014 | Establishment of Turf | 75 | Acre | _____ | _____ |
| 0015 | Silt Fences | 4,385 | Linear Foot | _____ | _____ |
| 0016 | Erosion Control Blanket | 58,500 | Square Yard | _____ | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 0017 | Environmental Protection | 1 | Lump Sum | XXX.XX | _____ |

GRAND TOTAL ITEMS 0001 THRU 0017 _____

NOTES

Bidders shall furnish unit prices for all items listed on the schedule of bid items that require unit prices. If the bidder fails to insert a unit price in the appropriate blank for required items, but does furnish an extended total or an estimated amount for such items, the Government will deem his unit price to be the quotient obtained by dividing the extended amount for that line item by the quantity. IF THE BIDDER OMITS BOTH THE UNIT PRICE AND THE EXTENDED ESTIMATED AMOUNT FOR ANY ITEM, HIS BID WILL BE DECLARED NONRESPONSIVE.

Award will be made as a whole to one bidder.

All quantities are estimated except where unit is given as “Lump Sum” or “Each”.

If a bid or modification to a bid based on unit prices is submitted and provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price, including lump sum units, in bid schedule must be stated, or, if it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.

Bidders are cautioned to read the contract clause entitled “Required Central Contractor Registration” located in Section 00700.

**QUANTITY ESTIMATES** - Estimates of quantities involved in certain items of work for which bids are being solicited on a lump sum or job basis have been made for the use of the Government. Copies of these quantity estimates may be obtained from the U S Army Engineer District Memphis, 167 North Main Street, Room 762, Memphis, Tennessee 38103-1894, telephone 901/544-3236, or visit our website at http://www.mvm.usace.army.mil/ It is to be expressly understood that the accuracy of these estimates is in no way warranted and that the furnishing of this information to a bidder will not relieve him of his responsibility to estimate the quantities involved. It is further to be expressly understood that in no case will such estimate be used as a basis of claim against the Government.

**Technical POC: Jerry Welch 901-544-3236**
Jerry.R.Welch@mvm02.usace.army.mil

**Administrative POC: Carol Seibert 901-544-3353**
Carol.J.Seibert@mvm02.usace.army.mil

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE CONSTRUCTION

SECTION 02371A

STONE FILLED WIRE MESH GABIONS AND MATTRESSES

-- End of Section Table of Contents --

SECTION 02371A

STONE FILLED WIRE MESH GABIONS AND MATTRESSES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 313/A 313M | (2003) Stainless Steel Spring Wire |
| ASTM A 370 | (2003a) Mechanical Testing of Steel Products |
| ASTM A 428/A 428M | (2001) Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles |
| ASTM A 641/A 641M | (2003) Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM A 764 | (1995; R 2001) Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs |
| ASTM A 809 | (2003) Aluminum-Coated (Aluminized) Carbon Steel Wire |
| ASTM A 856/A 856M | (2003) Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire |
| ASTM A 90/A 90M | (2001) Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings |
| ASTM A 974 | (1997; R 2003) Welded Wire Fabric Gabion and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated) |
| ASTM A 975 | (1997; R 2003) Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating) |
| ASTM B 117 | (2002) Operating Salt Spray (Fog) Apparatus |
| ASTM C 136 | (2004) Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 33 | (2003) Concrete Aggregates |

| | |
|---|---|
| ASTM D 1499 | (1999) Filtered Open-Flame Carbon-Arc Type Exposures of Plastics |
| ASTM D 2240 | (2004) Rubber Property - Durometer Hardness |
| ASTM D 412 | (1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers - Tension |
| ASTM D 5312 | (2004) Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions |
| ASTM D 638 | (2003) Tensile Properties of Plastics |
| ASTM D 746 | (2004) Brittleness Temperature of Plastics and Elastomers by Impact |
| ASTM D 792 | (2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement |
| ASTM G 152 | (2000ae1) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |

1.2 GENERAL REQUIREMENTS

The work under this specification includes furnishing, assembling, filling and tying open wire mesh rectangular compartmented gabions and mattresses placed on a prepared surface of filter material, , as specified, and in accordance with the lines, grades, and dimensions shown or otherwise established in the field.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Gabions or Mattresses
Alternative Wire Fasteners

Samples of the materials, used to fabricate the gabions or mattresses, shall be furnished to the Contracting Officer 60 days prior to assembly of units onsite and can be incorporated into the work upon approval by the government.

SD-06 Test Reports

Gabions or Mattresses
Alternative Wire Fasteners

For each shipment of wire gabions or mattresses delivered to the site, the Contractor shall furnish the Contracting Officer, in duplicate, test reports or records that have been performed during

the last year on all material contained within the shipment meets the composition, physical, and manufacturing requirements stated in this specification.

SD-07 Certificates

Stone Fill
Filter Material

A certificate or affidavit signed by a legally authorized official of the supplier of the stone fill and the supplier of the natural filter material that it meets the quality required and gradation limits specified.

1.4 DESCRIPTION

Gabions and mattresses are wire mesh containers of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures. Gabions and mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. The supply to the jobsite of unassembled individual wire mesh components (panels) forming gabions and mattresses will not be permitted. Definitions of terms specific to this specification and to all materials furnished on the jobsite, with the exception of the rock to fill the baskets and the filter material, shall refer and be in compliance with ASTM A 975 for double twisted wire mesh Gabions and Revet mattresses, or with ASTM A 974 for welded wire fabric Gabions and Gabion Mattresses. For ease of reference, the term "mattress" will be used in this specification in place of Revet mattress and/or Gabion mattress, where the statement is of general nature and it is not specific to the double twisted or welded wire mesh products.

1.5 DEFINITIONS

1.5.1 Double twisted wire mesh Gabions and mattresses

They consist of wire mesh made from wire which is zinc coated and overcoated with PVC before being double twisted into mesh. Fasteners, lacing wire, and stiffeners are produced from zinc-coated wire and overcoated with PVC. Fasteners shall be of stainless steel wire.

1.5.2 Welded Wire Fabric Gabions and Mattresses

They consist of welded wire fabric made from wire which is zinc coated before being welded into fabric and overcoated with PVC. Spiral binders, lacing wire, and stiffeners are produced from zinc-coated wire and overcoated with PVC.

1.6 Testing and Studies

1.6.1 Samples

Samples of materials used to fabricate the Gabions or Mattresses shall be furnished to the Contracting Officer 60 days prior to start of installation. Testing by the Contractor shall be in accordance with

specification and either ASTM A 974 or ASTM A 975 depending on which system is being furnished by the Contractor. The Government reserves the right to test additional samples to verify the submitted test records at the Government's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements.

1.6.2 Test Report or Documents

Copies of all test results shall be furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Double twisted wire mesh Gabions and Mattresses

Double twisted wire mesh Gabions and Mattresses shall be manufactured with a non-raveling mesh made by twisting continuous pairs of wires through three half turns (commonly called double twisted) to form a hexagonal-shaped opening. Gabion and mattress sizes, wire diameters, mesh opening sizes, and tolerances shall comply with the requirements of ASTM A 975. Gabions and Matresses shall meet the following test requirements:

a. Metallic coating - The coating weights shall conform to the requirements of ASTM A 641/A 641M, Class 3, ASTM A 90/A 90M or ASTM A 428/A 428M as applicable.

b. PVC for Coating - The PVC coating shall show no cracks or breaks after the wires are twisted in the fabrication of the mesh. The initial properties of PVC coating material shall have a demonstrated ability to conform to the following requirements:

1). Specific Gravity - In the range from 1.30 to 1.35 dN/dm3, when tested in accordance with test method ASTM D 792;

2). Tensile Strength - Not less than 2985 psi when tested in accordance with test method ASTM D 412;

3). Modulus of Elasticity - Not less than 2700 psi when tested in accordance with test method ASTM D 412;

4). Hardness - Shore "D" between 50 and 60, when tested in accordance with test method ASTM D 2240;

5). Brittleness Temperature - Not higher than 15 degrees F, or lower temperature when specified by the purchaser, when tested in accordance with test method ASTM D 746.

6). Resistance to Abrasion - The percentage of the weight loss shall be less than 12%;

7). Salt Spray Exposure and Ultra Violet Light Exposure - The PVC shall show no effect after 3,000 h of salt spray exposure in accordance with ASTM B 117. The PVC shall show no effect of exposure to ultra violet light with test exposure of 3,000 h, using apparatus Spectral Irradiance of Open Flame Carbon Arc with Daylight Filters and 145 degrees F, when tested in accordance with

practice ASTM D 1499 and ASTM G 152;

8). Evaluation of Coating After Salt Spray and Ultraviolet Exposure Test - After the salt spray test and exposure to ultraviolet light, the PVC coating shall not show cracks nor noticeable change of color, or blisters or splits. In addition, the specific gravity, tensile strength, hardness and resistance to abrasion shall not change more than 6%, 25%, and 10% respectively, from their initial values.

c. Wire Tensile Strength - The tensile strength of the wire used for the double twisted mesh, lacing wire, and stiffener, when tested in accordance with Test Methods and definitions ASTM A 370, shall be in accordance with the requirements of ASTM A 641/A 641M (Style 1), ASTM A 809 (Style 4), and ASTM A 856/A 856M (Style 2), for soft temper wire.

d. Mesh strength and panel to panel joint strength - The minimum strength requirements of the mesh, selvedge wire to mesh connection, panel to panel connection, and punch test, when tested in accordance with ASTM A 975 Section 13.1, shall be as shown in Table 1. The strength values reported in lb/ft are referred to the unitary width of the specimen. The panel to panel test shall demonstrate the ability of the fastening system to achieve the required strength, and indicate the number of wire revolutions for the lacing wire or the ring spacing for ring fasteners used. The same number of wire revolutions or ring spacing shall be used in the field installation. Pleating the based panel to obtain internal panels is prohibited.

TABLE 1

Minimum Strength Requirements of Mesh and Connections

| Test description | Gabions, metallic coated lb/ft | Gabions, PVC coated lb/ft | Revet mattresses (metallic and PVC coated) lb/ft |
|---|---|---|---|
| Tensile strength parallel to twist | 3500 | 2900 | 2300 |
| Tensile strength perpendicular to twist | 1800 | 1400 | 900 |
| Connection to selvedges | 1400 | 1200 | 700 |
| Panel to panel (using lacing wire or ring fasteners | 1400 | 1200 | 700 |

| Test description | Gabions, metallic coated lb | Gabions, PVC coated lb | Revet mattresses (metallic and PVC coated) lb |
|---|---|---|---|
| Punch Test | 6000 | 5300 | 4000 |

2.1.2 Welded Wire Fabric Gabions and Mattresses

Welded wire fabric Gabions and Mattresses shall be manufactured with a welded wire mesh composed of a series of longitudinal and transverse steel wires arranged substantially at right angles to each other, and welded together at the points of intersection by electrical resistance welding to

form fabricated sheets. Gabion and mattress sizes, wire diameters, mesh opening sizes, physical properties of the PVC for coating, and tolerances shall comply with the requirements of ASTM A 974. Gabions and Matresses shall meet the following test requirements:

a. Metallic coating - The coating weights shall conform to the requirements of ASTM A 641/A 641M, Class 3,ASTM A 90/A 90M or ASTM A 428/A 428M as applicable.

b. PVC for Coating - PVC adhesion test shall be PVC coating shall show no cracks or breaks after the wires are twisted in the fabrication of the mesh. The initial properties of the PVC coating on the wire and welded wire fabric shall have a demonstrated ability to conform to the following requirements:

1). Adhesion - The PVC coating shall adhere to the wire such that the coating breaks rather than separates from the wire, in accordance with test method ASTM A 974 Section 13.3;

2). Mandrel bend - The PVC-coated wire when subjected to a single 360 bend at 0 degrees F around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating;

3). Specific Gravity - In the range from 1.20 to 1.40 dN/dm3, when tested in accordance with test method ASTM D 792;

4). Tensile Strength - Not less than 2275 psi when tested in accordance with test method ASTM D 638;

5). Modulus of Elasticity - Not less than 1980 psi at 100% strain, when tested in accordance with test method ASTM D 638;

6). Hardness - Shore "A" not less than 75, when tested in accordance with test method ASTM D 2240;

7). Brittleness Temperature - Not higher than 15 degrees F, or lower temperature when specified by the purchaser, when tested in accordance with test method ASTM D 746.

8). Resistance to Abrasion - The percentage of the weight loss shall be less than 12%;

9). Salt Spray Exposure and Ultra Violet Light Exposure - The PVC shall show no effect after 3,000 h of salt spray exposure in accordance with ASTM B 117. The PVC shall show no effect of exposure to ultra violet light with test exposure of 3,000 h, using apparatus Spectral Irradiance of Open Flame Carbon Arc with Daylight Filters and 145 degrees F, when tested in accordance with practice ASTM D 1499 and ASTM G 152;

10). Evaluation of Coating After Salt Spray and Ultraviolet Exposure Test - After the salt spray test and exposure to ultraviolet light, the PVC coating shall not show cracks nor noticeable change of color, or blisters or splits. In addition, the specific gravity, tensile strength, hardness and resistance to abrasion shall not change more than 6%, 25%, and 10% respectively, from their initial values.

c. Wire Tensile strength - The tensile strength of the wire used for

the welded wire fabric, spiral binders, lacing wire and stiffeners shall be soft medium in accordance with ASTM A 641/A 641M. The cross-sectional area of the test specimen shall be based on the diameter of the metallic coated wire. All the wires used in the fabrication of gabions and mattresses must use the same temper wire per given order.

d. Weld Shear Strength - The minimum average shear value in pounds-force shall be 70% of the breaking strength of the wire or as indicated in the table as follows, whichever is greater, when tested in accordance with ASTM A 974 Section 13.4. Typical minimum average shear strengths as specified are as follows:

TABLE 2

Minimum average shear strength values for the welded mesh

| Wire Diameter inch | Min. Av. Shear Strength lbs | Min. Shear Strength lbs |
|---|---|---|
| 0.087 | 292 | 225 |
| 0.106 | 472 | 360 |
| 0.120 | 584 | 450 |

The material shall be deemed to conform with the requirements for weld shear strength if the average of the test results of the first four specimens or if the average of the test results for all welds tested comply with TABLE 2.

Panel to Panel Joint Strength - The minimum strength of the joined panels, when tested as described in ASTM A 974 Section 13.5, shall be as follows:

TABLE 3

Panel to panel joint strength for welded gabions

| Test Description | Gabions, Metallic coated lb/ft | Gabions, PVC coated lb/ft | (Revet mattresses metallic and PVC coated) lb/ft |
|---|---|---|---|
| Connection to selvedges | 1400 | 1200 | 700 |
| Panel to panel (using lacing wire or ring fasteners | 1400 | 1200 | 700 |

The strength values reported in lb/ft are referred to the unitary width of the specimen. The panel to panel test shall demonstrate the ability of the fastening system to achieve the required strength, and indicate the number of wire revolutions for the lacing wire used. The same number of wire revolutions shall be used in the field installation.

2.1.3 Alternative Wire Fasteners for Gabions and Mattresses

Subject to approval of the Contracting Officer, alternative fastening

systems may be used in lieu of lacing wire. Alternative fasteners to lacing wire recommended for woven wire gabions and mattresses, according to ASTM A 975, are steel ring fasteners for metallic coated gabions and mattresses, or stainless steel rings for PVC coated gabions and mattresses. Ring fasteners for woven wire gabions and mattresses shall comply with the minimum requirements indicated in paragaph Ring Fasteners below, and they shall develop a minimum panel to panel joint strength as indicated in TABLE 1. Alternative fasteners to lacing wire for welded wire gabions and mattresses, according to ASTM A 974, are spiral binders. Spiral binders for welded wire gabions and mattresses shall comply with the minimum requirements indicated in paragraph Spiral Binders below. Ring fasteners may alternatively be used for welded wire gabions or mattresses, provided that they comply with the minimum specified requirements (salt spray and pull-apart resistance). Connections panel to panel for welded gabions and mattresses with ring fasteners shall develop a minimum joint strength as indicated in TABLE 3. The Contractor shall provide a complete description of the fastener system and a description of a properly installed fastener, including drawings or photographs if necessary. The Contractor shall provide test results that demonstrate that the alternative-fastening system meets the requirements of the specifications, according to the following criteria:

a. That the proposed fastener system can consistently produce a panel to panel joint strength as indicated in the TABLE 1 for double twisted wire mesh gabions and TABLE 3 for welded wire mesh gabions;

b. That the proposed fastener system does not cause damage to the protective coating on the wire;

c. That the Contractor has the proper equipment and trained employees to correctly install the fasteners;

d. That proper installation can be readily verified by visual inspection.

Samples of wire fasteners with their certified test records shall be submitted at least 60 days in advance to the Contracting Officer for approval. The Government reserves the right to test additional samples to verify the submitted test records at the Government's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements.

2.1.3.1 Ring Fasteners

The tensile strength of the zinc-coated steel wire, zinc-5% aluminum coated mischmetal alloy-coated steel wire and aluminum-coated steel wire used for fasteners shall be in accordance with the requirements of ASTM A 764, Type A, B, or C, Table 2 or Table 3. The tensile strength of stainless steel wire used for fasteners shall be in accordance with the requirements of ASTM A 313/A 313M, Type 302, Table 2. Any fastener system shall give the number of fasteners required to comply with TABLE 1, in accordance with ASTM A 975 (Section 13.1.2) for woven wire gabions and mattresses, and TABLE 3, in accordance with ASTM A 974 (Section 7.3), for welded wire gabions and mattresses. Ring fasteners shall not be installed more than 4 inches apart. Each fastener type shall be closed and the free ends of the fastener shall overlap a minimum of 1 inch. The manufacturer or supplier shall state the number of fasteners required for all vertical and

horizontal connections for single and multiple basket joining. Approved ring fasteners including fasteners made of stainless steel shall be subject to the salt spray test and pull-apart resistance test and shall be documented by actual testing of panel to panel connections within the last year by validated laboratories.

a. Salt Spray Test - A set of two identical rectangular gabion panels, each with a width about 10-1/2 mesh openings along a selvedge wire, shall be joined by properly installed wire fasteners along the two selvedge wires so that each fastener confines two selvedge and two mesh wires. If the fasteners are also to be used to joint two individual empty gabion baskets, two additional selvedge wires which are each mechanically wrapped with mesh wires shall be included so that each fastener confines four selvedge and four mesh wires. The set of the jointed panels shall be subject to salt spray test, ASTM B 117, for a period of not less than 48 hours. At the end of the test, the fasteners, the selvedge, or mesh wires confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends. A properly installed fastener shall meet the following requirements:

1). Each interlocking fastener shall be in a locked and closed position.

2). Each ring fastener shall be closed, and the free ends of the fastener shall overlap a minimum of 1 inch.

b. Pull-Apart Resistance Test - A new set of the jointed panels, which are prepared by the same method as specified in the salt spray test but without being subject to the 48-hour salt spray test, shall be mounted on a loading machine with grips or clamps such that the panels are uniformly secured along the full width. The grips or clamps shall be designed to transmit only tension forces. The load will then be applied at a uniform rate of 50 lbs/sec until failure occurs. The failure is defined as when the maximum load is reached and a drop of strength is observed with subsequent loading or the opening between any two closest selvedge wires, applicable to a fastener confining either two or four selvedge wires, becomes greater than 2 inches at any place along the panel width. The strength of the jointed panels at failure shall have a minimum as indicated in TABLE 1 or TABLE 3.

2.1.3.2 Spiral Binders

Spiral binders are defined as a length of metallic coated steel wire or metallic coated steel wire with PVC coating preformed into a spiral, used to assemble and interconnect empty gabion and/or mattress units, and to close and secure stone-filled units. Spiral binders shall be fabricated with the same wire and coating style as the wire mesh. Test requirements for spiral binders shall refer to TABLE 3 regarding Metallic Coating, PVC for coating, Tensile Strength, and Panel to Panel Joint Strength.

2.1.4 Testing

Test records made within one year by certified laboratories and Government agencies will be used to determine the acceptability of the fastening system. Samples of wire fasteners and samples of material for fabricating the gabions and mattresses with their certified test records shall be submitted at least 60 days in advance to the Contracting Officer for approval. The Government reserves the right to test additional samples to verify the submitted test records at the Government's expense. When the

first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements.

2.1.5 Stone Fill

2.1.5.1 General

For gabions and mattresses, the ability to function properly depends upon their stability, which is partly depending upon the rocks filling them. Rock sizes should be chosen to prevent them from falling through the mesh of the gabions or mattresses. The rock has also to withstand natural weathering processes during the life of the project that would cause it to breakdown to sizes smaller than the wire mesh opening dimensions. Rock to fill gabions and mattresses shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used.

a. Delivery. Rock shall be delivered to the work site in a manner to minimize its reduction in sizes (breakdown) during the handling of the rock, and be placed and secured within the assembled and interconnected gabion or mattress.

b. Sources. The sources from which the Contractor proposes to obtain the material shall be selected well in advance of the time when the material will be required in the work. The inclusion of more than 5% by weight of dirt, sand, clay, and rock fines will not be permitted. Rock may be of a natural deposit of the required sizes, or may be crushed rock produced by any suitable method and by the use of any device that yields the required size limits chosen in TABLE 4.

c. Properties. Rocks shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure.

d. Non-listed Source. The Contractor may, as an option, propose to furnish stone from one non-listed source. The Government will make such investigations and tests as necessary to determine whether acceptable stone can be produced from the proposed source. Suitable samples of stone fill material shall be collected in the presence of a Government representative and submitted to the Contracting Officer for approval prior to delivery of any such material to the work site. Unless otherwise specified, all test samples shall be obtained and delivered at the Contractor's expense to work site at least 60 days in advance of the time when placing of the stone-filled gabions or mattresses is expected to begin. Suitable tests and/or service records will be used to determine the acceptability of the stone. In the event suitable test reports and service records are not available, as in the case of newly operated sources, the material may be subjected to petrography analysis, specific gravity, absorption, wetting and drying, freezing and thawing, and such other tests as may be considered necessary to demonstrate to the satisfaction of the Contracting Officer that the materials are acceptable for use in the work. All tests will be made by or under the supervision of the Government and at its expense.

2.1.5.2 Stone Quality

Stone fill, crushed stone, shall meet the quality requirements of ASTM C 33, and freezing and thawing requirements of ASTM D 5312 for the region of the United States in which the structure will be constructed.

2.1.5.3 Gradation

Gradation of stone for gabions shall be performed every 1000 tons placed under this contract in accordance with ASTM C 136. Sizes of rock to fill gabions and mattresses are chosen on the basis of the mesh sizes, the structure's thickness, and within the limits shown in TABLE 4. Within each range of sizes, the rock shall be large enough to prevent individual pieces from passing through the mesh openings. Each range of sizes may allow for a variation of 5% oversize rock by weight, or 5% undersize rock by weight, or both.

a. Oversize Rock. In all cases, the sizes of any oversize rock shall allow for the placement of three or more layers of rock within each gabion compartment and two or more layers of rock within each mattress compartment dependent upon the height of the mattress.

b. Undersize Rock. In all cases, undersize rock shall be placed within the interior of the gabion or mattress compartment and shall not be placed on the exposed surface of the structure. There shall be a maximum limit of 5% undersize or 5% oversize rock, or both, within each gabion or mattress compartment. The required rock gradation is reported in Table 4.

TABLE 4

Required rock gradation for gabions and mattresses

| Type of structure | Thickness (height) inch | Rock sizes inch |
|---|---|---|
| Mattresses | 6 | 3 - 5 |
| Mattresses | 9 | 3 - 5 |
| Mattresses or Gabions | 12 | 4 - 8 |
| Gabions | 18 or higher | 4 - 8 |

2.1.6 Filter Material

For filter material, refer to Section 02542, STONE PROTECTION, paragraph 2.2.

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PART 3 EXECUTION

3.1 MATERIAL DELIVERY

Gabions and mattresses shall be delivered with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. All gabions and mattresses are supplied in the collapsed form, either folded or bundled or

rolled, for shipping. Bundles are banded together at the factory for ease of shipping and handling. Mattress bases and lids may be packed in separate bundles.

a. Mattress lids may be supplied either as individual units (bundled) or in roll form. Lacing wire shall be shipped in coils with a diameter of the coil approximately 2 feet. Fasteners shall be shipped in boxes. Preformed stiffeners shall be shipped in bundles.

b. Gabions and mattresses shall be delivered to the jobsite labeled in bundles. Labels shall show the dimensions of the gabions or mattresses included, the number of pieces and the color code.

## 3.2 FOUNDATION PREPARATION

Foundation preparation may take place on frozen or snow-covered ground. After excavation or stripping, to the extent indicated on the drawings or as directed by the Contracting Officer, all remaining loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free-draining materials. Otherwise, the depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. Any debris that will impede the proper installation and final appearance of the gabion layer shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to placing the material, the Contracting Officer shall inspect the prepared foundation surface, and no material shall be placed thereon until that area has been approved.

## 3.3 FILTER PLACEMENT

For filter placement, refer to Section 02542, STONE PROTECTION, paragraph 3.2.

## 3.4 ASSEMBLY

### 3.4.1 Double twisted wire mesh Gabions

The gabions shall be opened and unfolded one by one on a flat, hard surface. Gabion units over 6 foot in length usually have an extra shipping fold, which must be removed. The sides, ends and diaphragms shall be lifted up into a vertical position to form an open box shape. The back and the front panels of the gabion shall be connected to the end panels and center diaphragms. The top corner of the end panels and center diaphragms have a selvedge wire extending approximately 4 inches out from the corner edge. The end panels and the diaphragms shall be raised to a vertical position and the selvedge wire shall be wrapped around the edge wire of the top and back panels.

### 3.4.2 Double Twisted Wire Mesh Revet Mattresses

The mattress shall be laid on a flat, hard surface. When the units are unfolded for assembly, depending on their length, they will have one or two shipping folds, which must be removed. The double flap of the side panel shall be folded in and wired to the diaphragm. At the corners, the end

flaps shall be folded along the sides and the joint laced up. Each Revet mattress shall be assembled individually, by erecting the sides, ends and diaphragms, ensuring that all creases are in the correct position and the tops of all sides are level.

3.4.3 Welded wire fabric Gabions and Gabion mattresses

The Gabions or Gabion mattresses shall be opened and unfolded on a flat, hard surface. The units shall be rotated into position and the edges joined with fasteners for assembly. Where spiral fasteners are used, the ends shall be crimped to secure them in place. Where lacing wire is used, the wire shall be wrapped with alternating double and single loops with spacings not to exceed 6 inches. Ends shall be secured with two complete revolutions and finished with a one-half hitch. The same fastening procedures shall be used to secure interior diaphragms and end panels. When two gabions are placed side by side, the two end panels may be connected along the vertical edges with a single spiral fastener.

3.5 LACING OPERATIONS

3.5.1 Double Twisted Wire Mesh Gabions and Mattresses

Either lacing wire or ring fasteners are permitted to lace double twisted wire mesh Gabions or Revet mattresses.

a. When using lacing wire, a piece of wire 1.2 to 1.5 times the length of the edge to be laced shall be cut off. If the edge of the basket is 3 foot long, no more than 4 to 5 feet of wire shoul be used at a time to lace. For vertical joints, starting at the bottom end of the panel, the lacing wire shall be twisted and wrapped two times around the bottom selvedge and double and single loops shall be alternated through at intervals not bigger than 4 to 6 inches. The operation shall be finished by looping around the top selvedge wire. The use of pliers to assemble the units with lacing wire is normally recommended.

b. When steel wire ring fasteners are used, the rings shall be installed at the top and bottom connections of the end and center diaphragms. The ring spacing shall be based on the minimum pull apart strength as specified in TABLE 1. In any case, the maximum ring spacing along the edges shall not exceed 6 inches. The use of either a mechanical or a pneumatic fastening tool for steel wire ring fasteners is required. Ring fasteners shall be galvanized, stainless steel or Zn-5% aluminum-mischmetal alloy coated.

3.5.2 Welded Wire Mesh Gabions And Mattresses

Either lacing wire or spiral binders are permitted to lace welded wire mesh Gabions or Gabion mattresses. The empty units shall be placed on the foundation and interconnected with the adjacent unit along the top, bottom and vertical edges using spiral fasteners. Lacing wire may be used in lieu of spiral binders for the interconnection of gabions or mattresses as specified above. The connection with lacing wire or spiral binders shall be based on the minimum panel to panel joint strength as specified in TABLE 3. Spiral binders shall be screwed along the connecting edges, and then each end crimped to secure the spiral in place. Each layer of gabions or mattresses shall be interconnected to the underlying layer along the front, back and sides.

## 3.6 INSTALLATION AND FILLING

Empty gabion and mattress units shall be assembled individually and placed on the approved surface to the lines and grades as shown or as directed, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position of all creases and that the tops of all sides are level. Finished gabion or mattress structures shall have no gaps along the perimeter of the contact surfaces between adjoining units. All adjoining empty gabion units shall be connected along the perimeter of their contact surfaces to obtain a monolithic structure. All lacing wire terminals shall be securely fastened. All joining shall be made through selvedge-to-selvedge or selvedge-to-edge wire connection; mesh-to-mesh or selvedge-to-mesh wire connection is prohibited except in the case where baskets are offset or stacked and selvedge-to-mesh or mesh-to-mesh wire connection would be necessary. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvedge or edge wire.

a. The initial line of basket units shall be placed on the prepared foundation and adjoining empty baskets set to line and grade, and common sides with adjacent units thoroughly laced or fastened. They shall be placed in a manner to remove any kinks from the mesh and to a uniform alignment. The basket units then shall be partially filled to provide anchorage against deformation and displacement during the filling operation. The stone shall be placed in the units as specified in paragraph 2.1.5 Stone Fill, subparagraph Gradation, part b.

b. Undue deformation and bulging of the mesh shall be corrected prior to further stone filling. Care shall be taken, when placing the stone by hand or machine, to assure that the PVC coating on gabions will not be damaged. All visible faces shall be filled with some hand placement to ensure a neat and compact appearance and that the void ratio is kept to a minimum.

c. Gabions and mattresses shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements. Gabions and mattresses can be filled by any kind of earth-filling equipment, such as a backhoe, gradall, crane, etc. The maximum height from which the stones may be dropped into the baskets shall be 3 to 4 feet. If PVC coated materials are used, no work shall take place unless the ambient temperature is above 20 degrees F.

### 3.6.1 Double twisted wire mesh Gabions

After the foundation has been prepared, the pre-assembled gabions shall be placed in their proper location to form the structure. Gabions shall be connected together and aligned before filling the baskets with rock. All connections (panel-to-panel) and basket-to-basket shall be already carried out as described in paragraph ASSEMBLY. Stone fill shall have a gradation of 4 to 8 inches, as described in paragraph Gradation, and shall be placed in 1 foot lifts. Cells shall be filled to a depth not exceeding 1 foot at a time. The fill layer should never be more than 1 foot higher than any adjoining cell. Stiffeners or internal cross ties shall be installed in all front and side of the gabions at 1/3 and 2/3 of the height for 3 feet or higher gabions, as the cell is being filled. Stiffeners shall be installed in the center of the cells. In 1.5 foot high units, stiffeners or internal crossties are not required. Internal cross ties, or alternatively the preformed stiffeners, shall be looped around three twisted wire mesh openings at each basket face and the wire terminals shall

be securely twisted to prevent their loosening. The number of voids shall be minimized by using a well-graded stone in order to achieve a dense, compact stone fill. All corners shall be securely connected to the neighboring baskets of the same layer before filling the units. When more than one layer of gabions is required, in order for the individual units to become incorporated into one continuous structure, the next layer of gabions shall be connected to the layer underneath after this layer has been securely closed. Gabions shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements.

3.6.2 Double Twisted Wire Mesh Revet Mattresses

After being assembled, the Revet mattresses shall be placed in their proper location and securely attached to the adjacent units. For structural integrity, all adjoining empty units shall be connected by means of lacing wire or ring fasteners along the edges of their contact surfaces in order to form a monolithic structure. Revet mattresses shall be placed and securely connected while empty. The filling shall be done unit by unit; however, several units can be pre-assembled prior to filling the units. Revet mattress units shall be filled with hard, durable, clean stone having a gradation as indicated in paragraph Gradation. Care shall be taken to ensure that diaphragm tops are accessible for wiring. On slopes, the Revet mattress shall be laid with the 6 foot dimension (width) longitudinally to the slope and progressing up the slope, except for small ditches or where otherwise specified in the project. When the installation is performed on a slope, the filling of the baskets shall start from the lower side of the bank. Where Revet mattresses are to be placed on steep slopes (3H to 2V), the units shall be secured by hardwood pegs driven into the ground just below the upper end panel, at 6 foot centers, or as specified in the project. When the Revet mattress is to be placed over a geotextile, care shall be taken to ensure that any projecting ends of wire are bent upward to avoid puncturing or tearing the cloth. Lids shall be securely connected to the ends of the mattress and to the top sides and diaphragms using alternate double and single loops, or steel wire ring fasteners, as indicated in paragraph FOUNDATION PREPARATION. In case that more adjacent bases are to be covered at one time, mesh rolls shall be used in place of unit size lids. Revet mattresses shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements.

3.6.3 Welded wire fabric Gabions

After the foundation has been leveled, the assembled gabions shall be placed in their proper location to form the structure. Care shall be taken to ensure that the top of the diaphragms are aligned correctly. The diaphragms shall be securely connected by either spiral binders or lacing wire. Gabions shall be connected together and aligned before filling them with 4 to 8 inch diameter rocks. Rock filling material shall be as specified in paragraph Gradation and shall be placed in 1 foot lifts. The fill layer shall be carefully hand-packed and braced to prevent bulging. Stiffeners shall be provided every 12 inch levels for 3 foot or higher gabions. Stiffeners shall be formed from lacing wire and placed across the corners at 12 inches from the corner, providing a diagonal bracing. Preformed hooked stiffeners can be utilized. Care shall be taken to ensure the number of voids is minimized by using a well-graded stone and avoiding large rocks to achieve a dense, compact compartment. After each 1 foot lift has been placed, it shall be leveled for the next lift. Almost all gabion structures consist of more than one course of gabions; in order that the individual gabions may become incorporated into one continuous structure, they shall be wired to neighboring gabions and the course below,

before filling. Gabions shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements.

3.6.4 Welded Wire Fabric Gabion Mattressses

After being assembled, the Gabion mattresses shall be placed in their proper location and securely attached to the adjacent units. For structural integrity, all adjoining empty units shall be connected by means of lacing wire or spiral binders along the edges of their contact surfaces in order to form a monolithic structure. Gabion mattresses shall be placed and securely connected while empty. The filling shall be done unit by unit; however, it is recommended that several units be pre-assembled prior to filling the units. Gabion mattress units shall be filled with hard, durable, clean stone having a gradation as indicated in paragraph Gradation. Care shall be taken to ensure that diaphragm tops are accessible for wiring.

a. On slopes, the Gabion mattress shall be laid with the 6 foot dimension (width) longitudinal to the bank, with the exception of small ditches or when otherwise specified in project. When the installation is performed on a slope, the filling of the units shall start from the lower side of the bank. Where Gabion mattresses are to be placed on steep slopes (3H to 2V), the units shall be secured by galvanized pipes driven into the ground inside the upper end panel, at 6 foot centers, or as specified in the project.

b. When the Gabion mattress is to be placed over a geotextile, care shall be taken to ensure that any projecting ends of wire are bent upward to avoid puncturing or tearing the cloth.

c. Lids shall be securely connected to the ends of the mattress and to the sides and diaphragms using alternate double and single loops, or steel wire ring fasteners, as indicated in paragraph FOUNDATION PREPARATION. In case that more adjacent bases are to be covered at one time, mesh rolls can be used in place of unit size lids. Gabions mattresses shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements.

3.6.5 Non-rectangular Shapes

Gabion and mattress units can conform to bends up to a radius of curvature of 60 to 70 feet without alterations. Units shall be securely connected together first, and be placed to the required curvature, holding them in position by staking the units to the ground with hardwood pegs before filling. For other shapes, bevels and miters can be easily formed by cutting and folding the panels to the required angles.

3.7 CLOSING

Lids shall be tightly secured along all edges, ends and diaphragms in the same manner as described for assembling. Adjacent lids may be securely attached simultaneously. The panel edges shall be pulled to be connected using the appropriate closing tools where necessary. Single point leverage tools, such as crowbars, may damage the wire mesh and shall not be used. All end wires shall then be turned in.

## 3.8 GROUTING

### 3.8.1 General

The stone filled wire mesh 3'x 3'x 3' key protection gabions and the stone filled wire mesh gabion mattress units 12 inches thick as indicated on the drawings shall be grouted. Grout shall be composed of Portland cement, water, clean sand, and an air-entraining admixture. The water-cement ratio shall be limited to a maximum value of 0.45 by weight, and the entrained air content shall be between 5 and 8 percent of the total grout volume. The grout mixture shall have a minimum compressive strength of 3,000 pounds per square inch at 28 days. The use of water reducing and accelerating admixtures will be subject to the approval of the Contracting Officer. The grout shall be mixed in a manner so as to produce a mixture having a consistency which will permit gravity flow into the interstices of the riprap within the key protection gabion and gabion mattress units with the use of wooden screeds and/or brooms. The grout shall be used in the work within 90 minutes after mixing. Retempering of grout will not be permitted. Gabions shall not be grouted when the ambient temperature is below 40 degrees F or above 85 degrees F unless approved by the Contracting Officer in writing, nor when the grout, without special protection, is likely to be subjected to freezing temperatures before final set has occurred.

### 3.8.2 Above Water Grouting

Prior to grouting, all surfaces of riprap within the gabions and the gabion basket units shall be wetted. The key protection gabion and gabion mattress units containing riprap shall be grouted in successive strips, approximately 10 feet in width, commencing at the lowest strip and working up the slope. Each batch of grout shall be dumped on the upper portion of the ungrouted part of the strip and worked into the voids between the stones, within the key protection gabion and gabion mattress units, and down the slopes. Grout shall be brought to the place for final deposit by approved means, and in no case shall grout be permitted to flow on the surfaces of key protection gabion and gabion mattress units containing riprap a distance in excess of 10 feet. Immediately after dumping a batch of grout, it shall be distributed over the surface of the strip by the use of wooden screeds and/or brooms and the grout worked into mesh openings of the key protection gabion and gabion mattress units and into the voids in the gabion riprap to completely cover the top layer of stones. Care shall be taken at all times so as not to damage the PVC coated wire mesh. Grout application and coverage shall be applied to provide a minimum grout penetration of 1½ inches below the wire mesh and a minimum grout cover thickness of 1½ inches above the wire mesh throughout the limits of the key protection gabion and gabion mattress units. After the minimum cover thickness has been obtained, the grouted surfaces shall be given a rough textured broom finish. After completion of any strip as specified, no workman, nor any load, shall be permitted on the grouted surface for a period of at least 24 hours. The surface of all grouted riprap shall be protected from rain, flowing water and mechanical injury for a period of at least 24 hours. The surface of all grouted key protection gabion and gabion mattress units containing riprap shall be protected from rain, flowing water, and mechanical injury for a period of at least 24 hours. The surface of all grouted key protection gabion and gabion mattress units shall be cured by keeping the surface continuously wet for a period of not less than 72 hours or by application of an approved curing compound.

3.8.3 Below Water Grouting

In the event the depth of water precludes the placement of grout in the dry, as determined by the Contracting Officer, the Contractor shall make provisions to place the grout by means of a tremie, a bottom dump bucket, or by pumping through a suitable pipe or hose. For below water grout placement, the Contractor shall make every effort to provide the coverage and thickness as specified in the ABOVE WATER GROUTING paragraph above with the least amount of disturbance to the grout during placement as possible to minimize weakening of the design mix. Broom finishing will not be required for below water grouting. Placement of grout below water shall be at no additional expense to the Government.

3.8.4 Tremie

A tremie shall consist of a metal tube having a diameter of not less than 6 inches. The tremie shall be supported so as to permit free movement of the discharge and over the entire top surface area to be grouted and so as to permit rapid lowering when necessary to retard or stop the flowing of grout. The discharge end shall be closed at the start of the work so as to prevent water from entering the tube and shall be entirely sealed. The tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of grout shall be induced by slightly raising the discharge end.

3.8.5 Bottom Dump Bucket

Placing of grout by the bottom dump bucket method shall conform to the following specification. The top of the bucket shall be open. The bottom door shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface area to be grouted and when discharged shall be withdrawn slowly until well above the surface area.

3.8.6 Positive Displacement Pump

Grout may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be not less than 3 inches to allow the grout mixture to be pumped. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The grout shall be supplied to the pump continuously. When pumping is completed, grout remaining in the pipeline shall be ejected without contamination of grout in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted. The pipeline shall rest on the surface area to be grouted when grout is being discharged.

3.8.7 Maintenance

The Contractor shall maintain the grouted gabions and gabion mattress units until accepted, and any material displaced prior to acceptance and due to the Contractor's negligence shall be replaced at his expense and to the lines and grades shown on the contract drawings.

-- End of Section --